Trains, Trucks and Vessels

Transportation and Distribution at PotashCorp

If last winter's deep snow and record cold proved anything, it was the need for enhanced rail capacity and operations in North America.

"PotashCorp has a three-pronged strategy to improve product delivery and customer service by rail," said Bob Felgenhauer, Vice President, Transportation and Distribution.

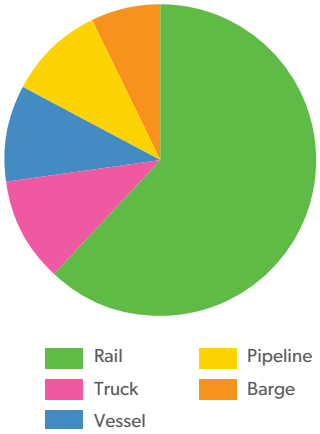
These include:

- Adding 1,000 railcars to our existing potash fleet, which will start delivering in the fourth quarter of 2015. Plus, an additional 600 railcars for UAN, poly and phosphoric acid service with delivery starting in the third quarter of 2015.
- Completing our new 120,000-ton warehouse at the Hammond, Indiana distribution facility prior to 2016, complementing our existing 1,000 railcar switching yard at that site and continuing to benefit from avoiding the Chicago bottleneck.
- Working closely with our transportation partners and customers to continuously improve the supply chain.

"Growth in the US economy – particularly commodities – translates into increased demand for transportation," explained Felgenhauer. "Last year's frigid weather impacted railways the most because demand outpaced the railways' ability to deliver given the structural challenges they faced."

Generally, the railways consider -25 degrees Celsius (-13 degrees Fahrenheit) to be "the tipping point" when trains need to be shorter, train speeds slower, and equipment more susceptible to failure. These conditions put a significant strain on an already stretched locomotive and crew base.

How PotashCorp ships its products in North America
(all three nutrients)



While no one can predict this winter's weather in advance, as a company we can do our best to prepare for more uncooperative weather ahead. Working together with the railways, PotashCorp will continue making transportation and distribution service levels a priority.

38 percent of the company's products are transported by non-rail methods such as trucks and pipeline.

In this issue

Review PotashCorp's strategy to improve product delivery and customer service by enhanced rail capacity and operations in North America.

Understand Liebig's law of the minimum to determine how a good crop nutrition program may help your bottom line.

See how last year's market trends can impact this year's fertilizer industry and discover considerations for transporting Lomag in cold weather conditions.

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agriviews

Robert Mullen, Ph.D.
Director of Agronomy
PotashCorp/PCS Sales

Allocating Your Fertilizer Dollar, Where Should You Invest?

This time of year there are typically several articles published in trade magazines and University bulletins discussing how farmers should make adjustments to input purchases (specifically fertilizer) to increase the profitability of their farming operations.

When budgets get tighter, one common recommendation is cutting back on potassium and phosphorus. This may be an option if you have an adequate supply of these nutrients in your soil. However, cutting back without evaluating soil test levels, and considering the agronomic and economic implications, is likely not a good decision.

The purpose of this article is to illustrate the importance of a good crop nutrition program, and why blindly cutting back on some fertilizer inputs could actually cost you money.

Liebig's Law of the Minimum

For those who have attended a soil fertility meeting or a crop nutrient management class, you have seen the barrel concept (Figure 1) used to illustrate Liebig's law of the minimum. Liebig's law states that the yield achievable is dictated by the nutrient that is most limiting. Stated using the barrel analogy, the amount of water a barrel will hold is a function of the length of the shortest stave.

Let's assume that potassium is the most limiting factor. If a field's yield potential is 220 bushels per acre (with adequate potassium nutrition), but soil test potassium level will only allow yield to reach 80 percent of the maximum, the actual yield achievable is 176 bushels per acre. This scenario assumes that all other nutrients are supplied at 100 percent sufficient levels (an assumption most forget to include when discussing the law of the minimum).

Remember, the goal of any agronomist is to proactively identify and remove yield-limiting factors. This concept applies to soil fertility, weed management, pathology, entomology and other agronomic considerations.

How does this apply to allocating your fertilizer dollar? Blindly cutting potassium or phosphorus and focusing the bulk of your fertilizer investment on nitrogen can be a yield-limiting, and profit-decreasing, decision. This is especially true if potassium or phosphorus have limited availability based upon soil test. The crop will respond to applying nitrogen fertilizer, but the yield achieved will be limited based on the extent of potassium and phosphorus inadequacy.

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Figure 1. Liebig's law of the minimum illustrated using the barrel stave concept.

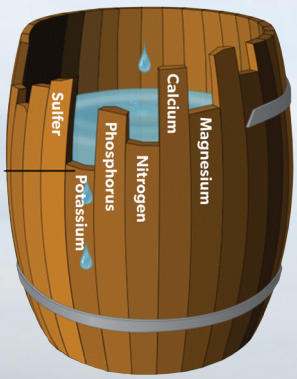


Figure 2. Corn response to nitrogen fertilization with and without phosphorus fertilization.

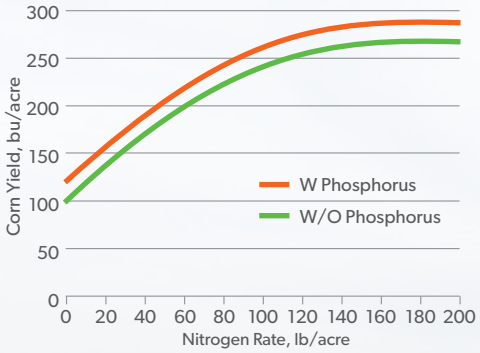
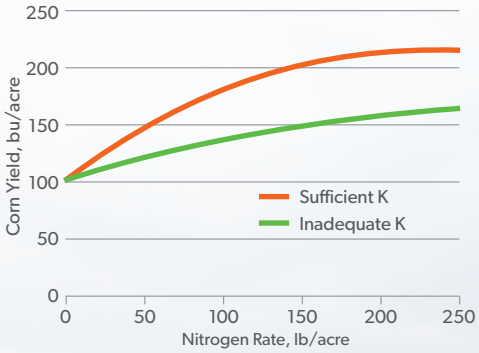


Figure 3. Corn response to nitrogen when inadequate potassium is supplied and when sufficient potassium is supplied.



Data from research conducted in Ohio (Better Crops, 1998).

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Figure 2 is a simple visualization of this concept. Notice the green line (representing corn yield with inadequate phosphorus) does increase as nitrogen application increases. However, also note that the red line (representing corn yield with adequate phosphorus) allows for a higher maximum achievable yield when nitrogen and phosphorus are supplied. In this example, the yield achievable with both adequate phosphorus and nitrogen is 20 bushels higher than with adequate nitrogen alone.

More Nutrient Interactions

Some nutrient inadequacies can actually affect the crop's ability to utilize other nutrients supplied. The most commonly mentioned nutrient interaction is nitrogen and potassium. The nature of the interaction is such that whenever potassium is inadequate, the crop can require more nitrogen to achieve the optimal nitrogen rate (the rate where yield is maximized) and typically at a lower yield level. A video discussing this interaction is available on our eKonomics website at potashcorp-ekonomics.com/latest-fertilizer-research/.

In Figure 3, the green line represents corn response to nitrogen whenever potassium is not adequately supplied. Note how corn yield never quite reaches a maximum, i.e., yield is still increasing in response to an increased supply of nitrogen. The red line represents a scenario where adequate potassium has been supplied. Notice how the corn crop achieves a higher yield, and reaches it at a lower nitrogen rate, compared to the inadequate potassium scenario.

Another benefit to maintaining adequate potassium availability in soil is the potential interaction with phosphorus. Unpublished field research conducted at Ohio State University from 1994-1999 revealed that in situations where soil test potassium was below the established critical level, corn and soybean yields could decrease by increasing the phosphorus fertilization rate. This yield decrease occurred three out of seven research years in corn, and three out of six research years in soybeans. The exact physiological mechanism that would cause crop yield to decrease as a result of increasing the phosphorus application rate in a soil environment with inadequate potassium is not well understood.

Research conducted on alfalfa reveals a similar interaction between phosphorus and potassium. This study was conducted over seven years at Purdue University (Berg et al., 2005). During the final two years of the study, it was noted that plots receiving no potassium fertilization experienced decreased alfalfa yield by increasing the phosphorus fertilization rate. Therefore, forgoing potassium fertilization not only limits production, but supplying additional phosphorus combined with poor potassium fertility can actually decrease productivity.

Data such as this points to the importance of identifying and removing each yield-limiting factor because nutrient interactions can and do occur.

Table 1. Economic impact of potassium fertilizer decisions for a corn crop based on yield potential, soil test level and commodity price.

Yield potential, bu/acre	Soil test level, ppm	Crop price, $ per bushel	Average return generated, $ per acre
180	75-100	3.00	23
		3.50	34
		4.00	45
	100-130	3.00	-2
		3.50	1
		4.00	5
220	75-100	3.00	38
		3.50	51
		4.00	64
	100-130	3.00	3
		3.50	7
		4.00	11

*Assumptions used in the Nutrient ROI calculator – State/Region – Midwest Hybrid, Nutrient analysis – 0-0-60, Potash retail price $500/ton, Desired fertilizer rate – University recommended rate.

Making the Agronomic… Economic

These agronomic concepts and realities obviously have an economic impact on the farming operation. Opting to skip fertilization of potassium or phosphorus (or really any limiting nutrient) in an effort to save money can actually decrease total economic profit.

On our eKonomics website (potashcorp-ekonomics.com) we have an ROI (return on investment) tool that can help you understand just how much average return is generated from your fertilizer investment.

Table 1 illustrates how yield potential, soil test level and commodity pricing influence the average economic return from potassium fertilization. Cutting potassium fertilization when soil test is below 100 ppm (parts per million) represents considerable lost economic return especially as commodity price increases. The economic penalty for cutting potassium fertilization decreases as soil test level climbs above 100 ppm, but as the commodity price increases the return-not-realized if fertilization is skipped also increases.

Make certain you know just how much yield – and economic return – you are leaving out in the field before making a decision for any crop.

References

Berg, W.K, S.M. Cunningham, S.M. Brouder, B.C. Joern, K.D. Johnson, J. Santini, and J.J. Volenec. 2005. Influence of phosphorus and potassium on alfalfa yield and yield components. Crop Science Society of America Journal 45:297-304.

Potassium interactions with other nutrients. 1998. Better Crops 82:12-13.

marketviews

Jeff Holzman
Director, Market Research
PotashCorp

Global **Market Trends**

The turn of the calendar provides an opportunity to look back at the events that shaped our business over the past 12 months and examine the factors that could impact the fertilizer industry in the coming year.

2014 Year in Review

For crop markets, the year was a tale of two halves. In the first half, crop prices were supported by strong demand, supply uncertainty in Ukraine/Russia and delayed planting in the US. The focus quickly shifted in the second half to ideal growing conditions in many Northern Hemisphere regions, particularly the US. The potential for a large global crop weighed on prices through most of the third quarter before some recovery occurred in the fourth quarter. The decline in crop prices boosted end-user margins, with livestock sector profitability improving dramatically.

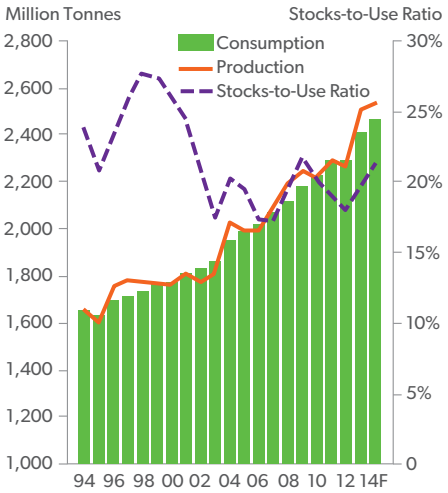
The major story in the potash market was the strain that robust demand placed on the supply chain. Low distributor inventories and strong growth in consumption drove global shipments to an all-time high of more than 61 million tonnes. Demand strength was most apparent in granular potash markets such as Brazil and North America. Logistical challenges in North America were more pronounced than in previous years due to an extremely cold winter and increased transportation demand from a wide range of industries. During second-half 2014, tight potash producer supplies further challenged timely product delivery.

Global ammonia and urea prices moved in opposite directions for much of the year. Supply constraints in key ammonia exporting regions such as Ukraine, Russia, North Africa and Trinidad resulted in a tighter market for this product. The US fall application season for ammonia was cut short, causing some seasonal weakness by the end of the year. Global urea prices were pressured by record Chinese exports and higher shipments from Middle Eastern producers. Strong US demand, and supply constraints in the first half, provided a more supportive domestic pricing environment.

Phosphate markets were volatile with significant price swings between peak and off-season demand. Despite weaker-than-expected demand from India, global phosphate trade increased on the back

Figure 1: World Grain and Oilseed Supply/Demand

Stocks Rise but Remain Well Below Historic Highs

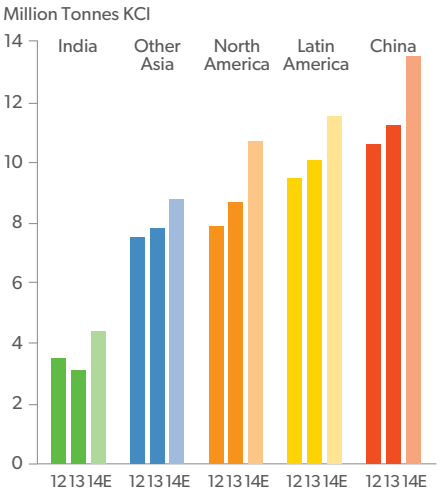


14F refers to the 2014/15 crop year.

Source: USDA

Figure 2: World Potash Shipments

Strong Demand Growth in All Major Potash Markets

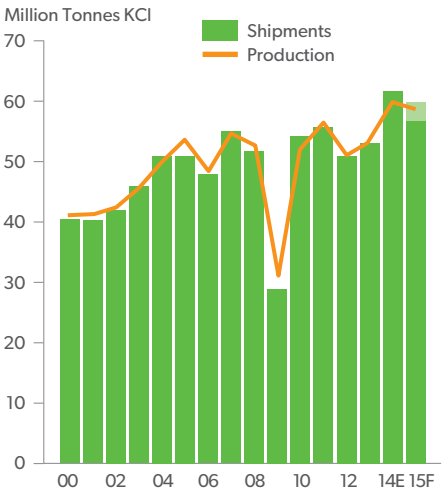


14E refers to the 2014/15 crop year.

Source: Fertecon, CRU, Industry Publications, PotashCorp

Figure 3: World Potash Shipments and Production

Record Potash Shipments in 2014 Has Reduced Producer Inventory



Source: Fertecon, CRU, Industry Publications, PotashCorp

of record shipments to Latin America and higher US imports. China, Morocco and Saudi Arabia increased their share of global trade and China emerged as a new supply source for US importers. Producers in the US adjusted to a changing competitive environment with the announcement of permanent capacity curtailments and shifts in product mix.

Factors to Watch in 2015

We enter the year with a moderated outlook for global commodity markets. Oil prices fell by more than 40 percent in the fourth quarter of 2014 — a sudden drop that has wide-ranging economic and geopolitical implications. The key factors to consider for agriculture markets include the impact on crop production costs, biofuel markets and foreign currencies (the US dollar has strengthened against the currencies of many competing agriculture-exporting countries).

Consecutive years of record world crop production have resulted in some replenishment of grain and oilseed stocks and a more moderate pricing outlook. Global harvested area expanded by nearly 90 million acres over the past five years and we anticipate a small reduction in acreage during 2015. For North America, we anticipate corn acreage will decline for the second consecutive year while soybean acreage is expected to remain high.

Despite a decline in crop prices compared to first-half 2014, we believe potash remains affordable at current levels and the need to replenish soil nutrients will be high after a record harvest. Following an especially robust year, we expect potash deliveries to decline modestly given improved distributor inventory. However, global potash shipments are projected to remain at historically high levels ranging between 58-60 million tonnes.

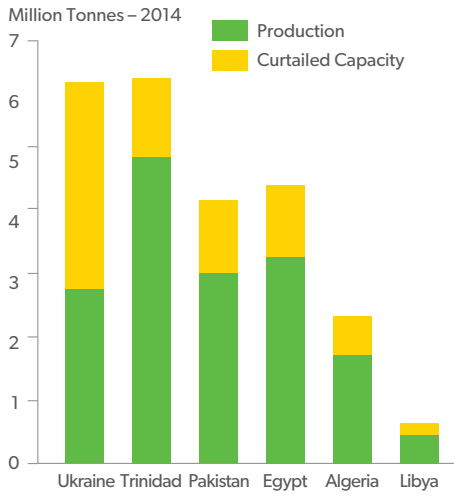
North American potash producers are expected to have increased operational capability in 2015 (assuming no project ramp-up issues), while Russian capacity could be reduced due to reported brine inflow problems at Uralkali's Solikamsk 2 mine. With lower North American producer inventories — and the potential for logistical constraints during the winter months — having product in place before the spring season will be important for fertilizer dealers.

As in recent years, the key factors in the nitrogen market will be reliability of supply from major ammonia-exporting countries and the monthly distribution of Chinese urea exports. We do not expect a resolution to many of the supply-side issues that impacted the ammonia market in 2014 but could see some cost relief for producers with oil-linked natural gas prices. China is expected to remain the world's largest urea exporter and its recent change to a flat annual export tax could reduce the seasonal volatility in urea prices. Given a shortened US fall ammonia season, and elevated imports of urea and UAN during the second half of 2014, we could see some product mix shifts during the spring season.

Phosphate has been a difficult market to predict over the past year with significant seasonal price variability. We anticipate this pattern will continue in 2015 but potentially with less intense pricing changes assuming a more stable supply/demand balance. India's DAP demand should increase as its inventories were drawn down in 2014. We expect Chinese exports will remain at elevated levels and incremental growth in demand will be met by additional supply from Morocco and Saudi Arabia. We anticipate a healthy spring season in the US with some phosphate application deferred from the fall, and foresee that imports will remain a major component of the domestic supply profile.

Figure 4: Regional Ammonia Production Profile

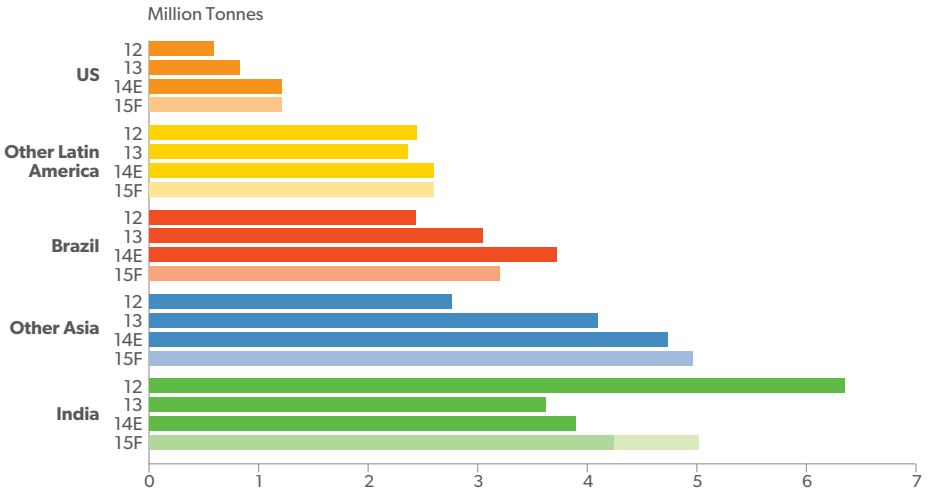
Significant Production Outages in Key Regions



Source: Fertecon, PotashCorp

Figure 5: DAP/MAP Imports by Major Region

Expect Improved Indian Demand; Imports Significant Component of US



Source: Potafertz, CRU, PotashCorp

Transporting Lomag in Winter Weather

Too cold to handle?

Imagine shipping a railcar loaded with hot molasses – it pours in easily enough but when it cools off, it's like, well…molasses in January.

Lomag, a superphosphoric acid produced by PotashCorp, is not so different. Lomag is loaded into insulated railcars at a scorching minimum temperature of 200 degrees Fahrenheit. As the railcar begins its journey, the molten product begins to cool off at a rate of approximately five degrees a day.

"The acid's viscosity increases as the railcar cools during transit and if the product's temperature drops too low, the acid can actually freeze," said Timothy Jestness, Manager, Phosphate Technical Services based out of our Aurora, North Carolina facility.

"Also the car's contents do not cool off uniformly – the top and bottom of the cars cool faster than the center. Eventually the Lomag becomes that thick molasses-type product that cannot be unloaded without completely reheating the railcar and creating an adequate flow."

To establish a flow, savvy customers practice air sparging of the acid. This is a process that blends the cooler product at the bottom with the hotter product in the center of the railcar.

As a service to customers, PotashCorp's technical support team can be dispatched to provide personalized training if a customer is unaware of techniques that can be used to process Lomag in the colder months. The process of establishing a flow from a cold Lomag railcar is best explained through hands-on customer training.

"My number one piece of advice to customers is don't wait to unload a railcar in hopes that the weather will improve. The longer the acid sits, the colder and thicker it gets," advised Jestness.

For technical support with Lomag railcars, customers can contact:

John Walker	jpwalker@pcsphosphate.com
Mark Mitchell	mamitchell@pcsphosphate.com
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Field Reports is published by PotashCorp. Should you have any questions or comments, please contact Customer Service at (800) 654-4514.

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